### Project Organization and Resource Coordination

John Kelley IceCube Director of Operations

SCAP 2025 April 2, 2025







## Outline

- Project Organization
  - ICNO organization chart
  - Work Breakdown Structure
  - M&O management and coordination
- Financial Management and Status
  - overview
  - current M&O award
  - common fund contributions and expenses
  - in-kind contributions
  - budget and actuals
  - labor inflation and mitigation







# **ICNO** Organization Chart

University of Wisconsin–Madison J. Mnookin, Chancellor D. Grejner-Brzezinska, Vice Chancellor for Research (VCR)	National Science Foundation	International Oversight and Finance Group	t Inte	ternational Funding Agencies				
Wisconsin IceCube Particle Astrophysics Center (WIPAC) D. Hooper, Director C. Lowney, Assoc. Director A. King-Klemperer, Communications K. Nutting, Business IT Support D.	IceCube Neutrino Observatory Halzen, Principal Investigator Kelley, Director of Operations Karle, Associate Director for Science & Instrumentation Hooper, Associate Director for Education & Outreach	IceCube Neutrino Observatory en, Principal Investigator y, Director of Operations e, Associate Director for ience & Instrumentation per, Associate Director for ucation & Outreach		be Collaboration Board Merson & Executive Inmittee Chair, I. Taboada (GTech) mm. Chair, E. O'Sullivan (Uppsala) s Comm. Chair, A. Ishihara (Chiba) -Gen2 Coordination Comm. Chair, Kowalski (DESY)				
Detector M&O – M. Kauer (UW, Manager)         DAQ Lead       J. Braun (UW)         South Pole System &         Test System       R. Auer (UW)         Supernova DAQ       S. BenZvi (Rochester)         Processing & Filtering       E. Blaufuss (Maryland)         IceTop Operations       S. Tilav (Delaware)         IceCube Live       M. Frère (UW)         Run Coordination       W. Thompson (Harvard)         Calibration – D. Williams (Alabama) / A. Terliuk (TU         Data Processing & Simulation – J.C. Díaz Vélez (U         Offline Data Production       R. Snihur (UW)         Simulation Production       K. Meagher (UW)         Program Coordination – L. Mercier (UW)         Collaboration Simulation Production Centers:         Belgium: IIHE-Brussels; Canada: Alberta; Japan: Chib Germany: DESY, Aachen, Dortmund, Wuppertal, Ma	nance & Operations South Pole Logistics, R&D Support Quality & Safety – M. Zernick (UW Computing & Data Mgt. – B. Riece Data Storage Sys. & Cybersecurity Data Transfer and Archive Data Management Distributed Computing Data Processing M) Networking and Facilities JW) Data Archive at DESY Data Archive at DESY Data Archive at LBNL Software – E. Blaufuss (Maryland) IceTray Framework/Development Simulation Software Offline Processing Software	ort – M. Kauer (UW) () Hel (UW, Manager) () S. Barnet (UW) P. Meade (UW) M. Preston (UW) V. Brik (UW) A. Sheperd (UW) S. Barnet (UW) D. Schultz (UW) K. Leffhalm (DESY) S. Klein (LBNL) t. D. La Dieu (Maryland) M. Larson (Maryland) T. Yuan (UW)	oordination mittee Chair Riedel (UW) Resource oordination Mercier (UW) TFT oordination Blot (DESY) Real-Time Oversight Committee Franckowiak (Bochum)	Working Groups Analysis Coordinator – N. Kurahashi Neilson (Drexel) Deputy Analysis Coordinator – S. BenZvi (Rochester) IceCube Upgrade Coordinator – J.P. Yañez (Alberta) Technical Coordinator – M. Larson (Maryland) Analysis Working Groups: Diffuse Neutrino Sources Beyond Standard Model Cosmic Rays Oscillation Low-Energy Astrophysics Technical Working Groups: Real-time Calibration				



# Work Breakdown Structure (WBS)







# M&O Management and Coordination

- Technical work by WBS
  - 2.2 Detector Operations: weekly operations calls
  - 2.3 Computing: daily standups, bi-weekly sprints
  - 2.4 Data Processing and Simulation: bi-weekly calls
  - 2.5 Software: bi-weekly software calls
  - 2.6 Calibration: weekly calibration calls
- M&O interface with physics working groups
  - bi-weekly IceCube Technical calls
  - Trigger, Filter, Transmission Board coordinates trigger, filter, and satellite resource usage
    - recently rejuvenated for offline filter rework, Pass 3 reprocessing, and Upgrade
  - IceCube Coordination Committee (ICC)
    - reorganized as part of Tech call
    - computing coordination currently managed by the ICC chair (B. Riedel)
- M&O leadership and cross-WBS coordination
  - bi-weekly M&O leadership meetings
  - weekly calls with NSF program officers
  - bi-annual reports to NSF, collaboration (general and ICB), and annually to IOFG









## Monetary Flow and Accounts



#### Expenditures



Current M&O Award (2021–25)



#### Budget summary table

NSF Funds	Budget Flements							
Request	Budget Liements	YEAR1	YEAR2	YEAR3	YEAR4	YEAR5	TOTAL	
A	Total Senior Personnel	\$308,770	\$314,944	\$343,955	\$350,833	\$357,850	\$1,676,352	
В	Other Personnel	\$2,344,998	\$2,388,752	\$2,487,896	\$2,583,654	\$2,635,327	\$12,440,627	
A+B	Total Salaries and Wages	\$2,653,768	\$2,703,696	\$2,831,851	\$2,934,487	\$2,993,177	\$14,116,979	
С	Total Fringe	\$891,662	\$908,442	\$951,498	\$985,984	\$1,005,708	\$4,743,294	
A+B+C	Total Salaries + Fringe	\$3,545,430	\$3,612,138	\$3,783,349	\$3,920,471	\$3,998,885	\$18,860,273	
D	Capital Equipment	\$0	\$0	\$0	\$0	\$0	\$0	
E1	Travel Domestic	\$132,217	\$136,004	\$141,702	\$146,585	\$149,467	\$705,975	
E2	Travel Foreign	\$85,869	\$88,766	\$92,685	\$95,447 \$97,315		\$460,082	
G1	Materials & Supplies	\$72,679	\$72,921	\$73,136	\$73,617	\$73,975	\$366,328	
G3	Consultant Services	\$0	\$0	\$0	\$0	\$106,405	\$106,405	
G4	Computer Services	\$30,000	\$75,000	\$75,000	\$75,000	\$75,000	\$330,000	
G5	Subawards	\$1,035,147	\$1,097,785	\$1,175,968	\$1,326,791	\$1,292,235	\$5,927,926	
G	Total Other Direct Cost	\$1,137,826	\$1,245,706	\$1,324,104 \$1,475,407		\$1,547,615	\$6,730,659	
H (A thr G)	Total Direct Costs	\$4,901,342	\$5,082,614	\$5,341,840	\$5,637,910	\$5,793,282	\$26,756,989	
I1	Labor Indirect	\$1,949,986	\$2,004,736	\$2,099,762	\$2,175,861	\$2,219,380	\$10,449,725	
12	Travel Indirect	\$119,935	\$124,752	\$130,102	\$134,335	\$136,959	\$646,083	
13	Materials & Supplies Indirect	\$39,973	\$40,471	\$40,591	\$40,857	\$41,056	\$202,949	
I4	Overhead Setup	\$82,500	\$0	\$0	\$0 \$		\$82,500	
15	Consultant Services Indirect	\$0	\$0	\$0	\$0	\$59,055	\$59,055	
16	Computer Services Indirect	\$16,500 \$41,625 \$41,625 \$41,625 \$		\$41,625	\$183,000			
I	Total Indirect Cost	\$2,208,894	\$2,211,584	\$2,312,080	\$2,392,678	\$2,498,075	\$11,623,311	
J=H+I	Total Direct & Indirect	\$7,110,237	\$7,294,199	\$7,653,920	\$8,030,589	\$8,291,357	\$38,380,301	



- M&O budget largely flat vs. time
- Most equipment (e.g. computing) not on award budget
- Increase in PY3–PY5 intended to assist in Upgrade operations



#### Software Effort: 2021–26 Award vs. Proposal



- Original 2021–26 M&O proposal added ~5 FTEs
  - +2.0 offline processing / core software developer
  - +1.0 distributed workflow software developer (PY3–5)
  - +1.0 simulation GPU software developer
  - +1.0 detector simulation software developer
  - +0.25 event visualization software developer
- Awarded additional ~1.5 FTEs. Original plan:
  - +1.0 simulation GPU software developer
  - +1.0 detector simulation software developer (PY4–5)



# Modified 5-Year Operational Plan



- COVID-induced delay of Upgrade deployment shifted our timescale for software development and support
  - prioritized DAQ integration development (rehire after a retirement)
  - +1.4 FTE scientist on simulation, reconstruction, and core software development
  - +1.0 FTE system administrator (shared computing / detector ops)
- Major focus in PY5 is wider Upgrade integration support
  - Upgrade simulation development (in-kind and with existing resources)
  - +1.0 FTE in-kind core software developer (Simon Frasier)
  - +1.0 FTE experiment control software developer (May 2025)
- Deferred software maintenance in:
  - IceCube event visualization (basic maintenance only)
  - GPU-based photon propagation (some effort funded on separate award)
  - ML workflow development



# **Common Fund Contributions**



- Both U.S. and non-U.S. full member institutions contribute to IceCube M&O via the common fund
  - \$13,650 / Ph.D. author / year
- U.S. Common Fund: NSF award increment divided into appropriate accounts based on current author count
- Non-U.S. Common Fund: WIPAC invoices foreign institutions annually
  - ~\$800K / year plus in-kind contributions
- Used to support "core activities that are agreed to be of common necessity for reliable operation of the IceCube detector and computing infrastructure" including:
  - winterover detector operators
  - data acquisition and filtering hardware and software at the South Pole
  - · data transfer and archival hardware and software at the WIPAC data center



# In-Kind Labor Contributions



- M&O labor contributions tracked through the MoU Dashboard
  - updates solicited bi-annually by Resource Coordinator
  - Institutional Leads update and confirm SoW
- Coordination boards prioritize
   work, set tasking
  - lack of feedback mechanisms has proved challenging
- Successful efforts have been focused and not organized through the dashboard
  - new offline filtering
  - Upgrade software task matrix

/ MOU / IceCul	be M&O			IceCube M&O	IceCube Upgrade	User Guide PDF ■ jkelley Log Ou
") VIEW A SNAPSHOT		L	JW-Madison			SAVED
	PHDS & AUTHORS 28	FACULTY 5	SCIENTISTS/POST-DOCS	GRADUATE STUDEN		
UW-MADISON'S STATEMENTS OF	WORK					
AD – Administration KE – Key Personnel (Faculty)	CS – Computer Science MA – Manager	DS – Data Science PO – Postdoctoral Ass	EN – Engineer ociates SC – Scientist	ing	GR – Graduate (PhD) Students WO – Winterover	IT – Information Technology
			+ 101410			

	CREATE NEW STATEMENT OF V	EMENT OF WORK		OF WORK	± TOTALS		SHOW PAGES	EXPORT	
	WBS L2 \$	WBS L3	\$	LABOR <sub>\$</sub> CAT.	NAME			$\Rightarrow$ SOURCE OF FUNDS (U.S. $\Rightarrow$ ONLY)	FTE \$
×	2.1 Program Coordination	2.1.1 Administr	ation	AD	Lowney, Christy	Management/Administr	ation	NSF M&O Core	0.1
×	2.1 Program Coordination	Program Coordination 2.1.1 Administration		AD	MERCIER, LAURA	IceCube Resource Adn	eCube Resource Administrator Manager NSF M&O Core		
×	2.1 Program Coordination	Program Coordination 2.1.1 Administration		GR	UW GR	Detector monitoring shi	ifts	NSF Base Grants	0.3
×	2.1 Program Coordination	Program Coordination 2.1.1 Administration		KE	HALZEN, FRANCIS	Principal Investigator		NSF M&O Core	0.25
×	2.1 Program Coordination	tion 2.1.1 Administration		KE	HALZEN, FRANCIS	Principal Investigator	Principal Investigator		0
×	2.1 Program Coordination	2.1.1 Administration		KE	HANSON, KAEL	Co-PI M&O		NSF M&O Core	0
×	2.1 Program Coordination	2.1.1 Administr	ation	KE	Halzen, Francis	Ы		NSF Base Grants	0.25
×	2.1 Program Coordination	2.1.1 Administr	ation	KE	KARLE, ALBRECHT	Co-PI M&O, Associate	Dir. Science Instr.	NSF M&O Core	0.5
×	2.1 Program Coordination	2.1.1 Administr	ation	KE	KARLE, ALBRECHT	ExecCom member		US In-Kind	0
×	2.1 Program Coordination	2.1.1 Administr	ation	KE	Lu Lu			NSF Base Grants	0.2
×	2.1 Program Coordination	2.1.1 Administr	ation	KE	VANDENBROUCKE, JUSTIN	PubCom member		US In-Kind	0
×	2.1 Program Coordination	2.1.1 Administr	ation	МА	Kelley, John	Director of Maintenance	e and Operations	NSF M&O Core	0.25
×	2.1 Program Coordination	2.1.1 Administr	ation	MA	MADSEN, JIM	Interim Director of M&C	)	NSF M&O Core	0.17



# **Budget and Expenditures Summary**



PY1–PY4 actual vs. budget

	(a)	(b)	(c)	(d)= a-b-c	(e)	(f)= d-e
	PY1-PY4 Budget	Actual Cost to	Open Commitments	Current Balance	<b>Remaining Projected</b>	End of PY4 Forecast
al	(Apr 2021 –	date			Expenses through	Balance as of Mar.
	Mar 2025)	Through January			March 31, 2025	31, 2025
		31, 2025				
	\$30.089M	\$28.101M	\$846K	\$1.141M	\$1.131M	\$10K

- PY1–PY4 projected balance is +\$10K
  - open commitments are subawards yet to invoice us
  - this is after some labor expenses shifted off award (next slide)
- Inflation has increased faster than award escalation
  - COLAs mandated by states of Wisconsin, Maryland
  - personnel departures + rehiring at market rates



# Inflation Mitigation





- M&O labor FTEs under budgeted plan
  - action is still needed due to labor inflation
- Labor rebalanced between U.S. and Non-U.S. Common Funds
  - core hardware and software maintenance
- South Pole server upgrade deferred until after Upgrade installation
  - solid logistical and financial reasons
    - ~\$800k deferred
    - focus on Upgrade pole activities
  - minimal technical risk





# Non-U.S. Common Fund Expenditures

System	Computing Infrastructure	Detector Infrastructure	Labor	Total
South Pole System + Test System	\$4K	\$17K	\$201K	\$222K
Data Warehouse + UW Data Center	\$533K	_	\$21K	\$554K
PY1 TOTAL	\$537K	\$17K	\$222K	\$776K
South Pole System + Test System	\$231K	\$3K	\$162K	\$396K
Data Warehouse + UW Data Center	\$111K	—	\$56K	\$167K
PY2 TOTAL	\$342K	\$3K	<b>\$218K</b>	\$563K
South Pole System + Test System	\$281K	\$40K	\$330K	\$651K
Data Warehouse + UW Data Center	\$867K	—	\$75K	\$942K
PY3 TOTAL	\$1,148K	\$40K	\$405K	\$1,593K
South Pole System + Test System	\$84K	\$10K	\$298K	\$392K
Data Warehouse + UW Data Center	\$185K		\$118K	\$303K
PY4 TOTAL	\$269K	\$10K	\$416K	\$695K



#### Major Hardware Investments (Non-U.S. CF)



PY1	<ul> <li>initial data warehouse Ceph upgrade (\$500k)</li> </ul>
PY2	<ul> <li>initial SPTS/SPS networking upgrade (\$230k)</li> <li>A40 GPU system (\$60k)</li> </ul>
РҮЗ	<ul> <li>data warehouse expansion + Ceph upgrade (\$540k)</li> <li>SPS networking + UPS upgrades (\$490k)</li> <li>database + VM server upgrades (\$110k)</li> <li>additional NPX worker nodes (\$80k)</li> <li>L40 GPU system (\$75k)</li> </ul>
PY4	<ul> <li>interactive compute + Kubernetes worker upgrades (\$175k)</li> <li>additional NPX worker nodes (\$105k)</li> </ul>
PY5 (planned)	<ul> <li>GPU upgrades (\$250–\$300k)</li> </ul>



# Summary



- M&O software and computing supported in multiple ways
  - NSF awards, common fund, and in-kind contributions
  - working to improve active communication with collaboration stakeholders
  - continue to work to direct and manage in-kind contributions
- Labor inflation challenging but under control
  - some maintenance deferred (SPS servers) but minimal technical risk
  - will need to be addressed after Upgrade construction completion
- Significant hardware upgrades in PY1-4
  - largely funded by Non-U.S. Common Fund
  - caught up post-COVID





# Supplemental Slides





### Subawards

			Dollars							
Institution	Major Responsibilities	Average FTE PY1–PY5	PY1	PY2	PY3	PY4	PY5		То	tal PY1-PY5
Lawrence Berkeley National Laboratory	Computing infrastructure, long-term data archival, DOM firmware support	.05 Senior Personnel .14 Other Professional	\$ 82,688	\$ 91,822	\$ 95,571	\$ 106,807	\$	110,475	\$	487,363
Pennsylvania State	Simulation production, DAQ firmware support	.24 Post-Doctoral Scholars .25 Other Professionals	\$ 23,098	\$ 39,055	\$ 96,850	\$ 162,966	Ş	106,943	\$	428,912
University of Delaware	IceTop calibration, monitoring and maintenance;IceTop simulation production	.65 Senior Personnel .25 Post-Doctoral Scholars	\$ 174,104	\$ 177,554	\$ 181,075	\$ 184,663	\$	188,328	\$	905,724
University of Maryland at College Park Original	Overall software coordination, IceTray software framework, online filter, simulation software and production	.02 Senior Personnel 2.4 Other Professional	\$ 635,366	\$ 643,918	\$ 652,605	\$ 718,288	\$	728,089	\$	3,378,266
After CR PY3-PY5	same as above	.02 Senior Personnel 2.5 Other Professional	\$ 635,366	\$ 643,918	\$ 762,484	\$ 811,590	Ş	812,369	Ş	3,665,727
University of Alabama at Tuscaloosa	Detector calibration, reconstruction and analysis tools	.08 Senior Personnel	\$ 30,101	\$ 30,703	\$ 31,318	\$ 31,944	\$	32,584	\$	156,650
Michigan State University	Simulation production, Northern Test System (NTS) maintenance	.2 Post-Doctoral Scholars	\$ 89,792	\$ 114,733	\$ 118,549	\$ 122,123	\$	125,817	\$	571,014

CR in PY3 to increase Univ. of Maryland subaward (same total budget)



# In-Kind Computing and Hardware Contributions

- In-kind computing resources integrated into IceCube grid
  - tracked per site and by resource type (CPU / normalized GPU)
  - DESY, MSU, Harvard, KIT, UMD et al. contributions
- Specialized hardware contributions also support M&O
  - example: surface array scintillator panels from KIT







## Work Breakdown Structure (WBS) to L3



